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Hank

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[54] **ARRANGEMENT FOR WINDING OF WEBS**

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[52] **U.S. Cl.** **242/66,** 242/75.1, 242/75.47, 242/75.51

[51] **Int. Cl.**.....**B65h 17/12,** B65h 25/22

[58] **Field of Search**.....242/75.51, 75.5, 242/75.45, 75.44, 75.43, 66, 75.1, 75.47

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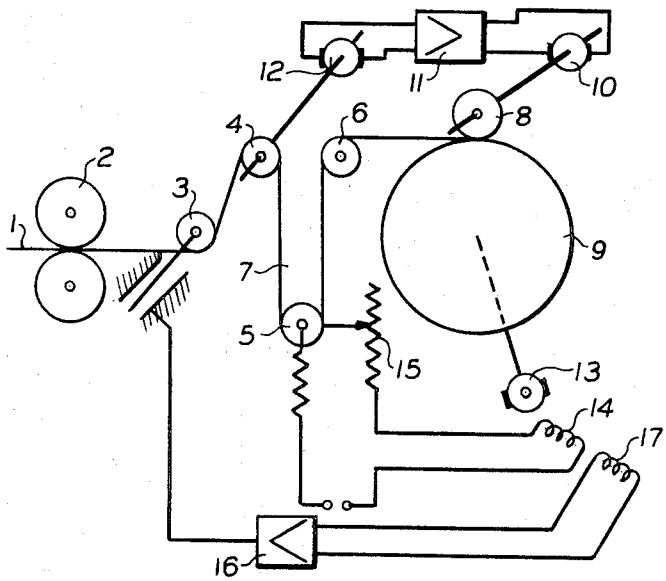
[57] **ABSTRACT**

An arrangement of winding up webs having a predetermined web tension, which comprises a compensating roller movably arranged in a loop formed by the web, the movement of the compensating roller being utilized to regulate the winding speed. A draw-in roller is arranged in front of the loop of the web, the latter being loaded down by the compensating roller, and being driven proportionally. An air-squeezing roller produces the peripheral speed of the roller capable of driving the draw-in roller proportional to the peripheral speed of the roller.

3 Claims, 3 Drawing Figures



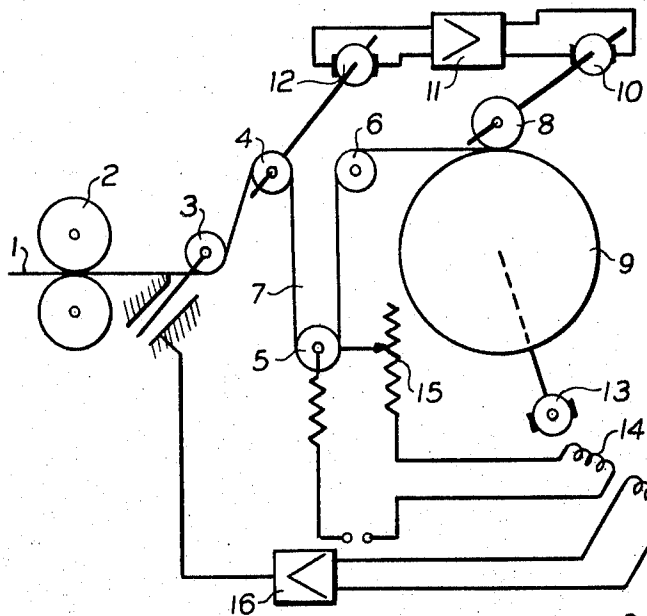


FIG. 1.

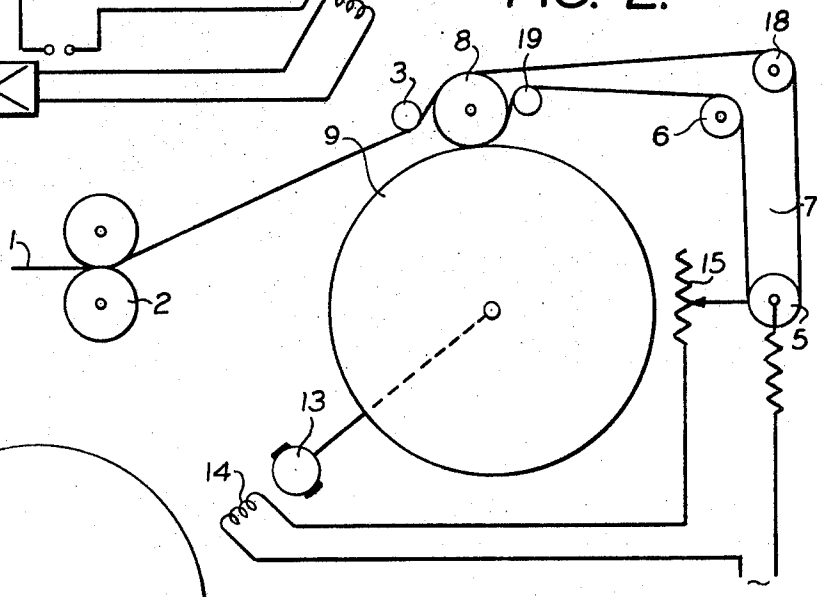


FIG. 2.

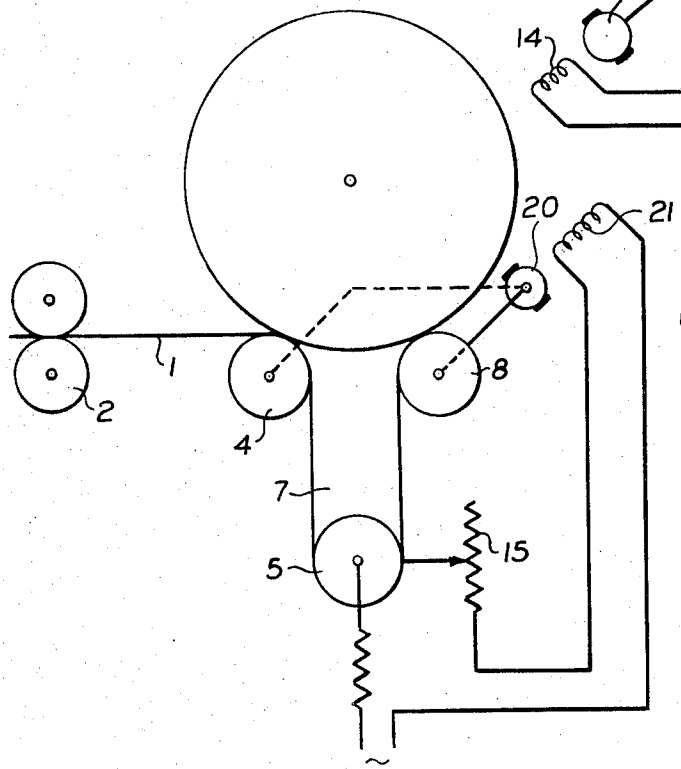


FIG. 3.

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ARRANGEMENT FOR WINDING OF WEBS

The present invention relates to a device for the winding up of webs, which arrive from a web processing or treating device, with a predetermined tension of the web, with the use of a compensating roller.

It is generally known to measure in windings, with the use of a compensating roller differences in speed which occur between the entrance into the compensating-roller loop and the emergence from the same and effect a movement of the compensating roller within the loop. The movement of the compensating roller brings about, via a control device, a change in the speed ratio between the entrance and the emergence, so as to accommodate the speeds. The tension of the web is determined by the mass of the compensating roller or by the load of the web loop by the compensating roller.

From a standpoint of control technique, it is extremely difficult and expensive to control variations in speed occurring at the entrance upon slight variations in tension of the web up to the drive of the roller or to the roller itself. The compensating roller exhibits from a control standpoint an integral action, the roller exhibits a proportional behavior with such a great retardation that it for all practical purposes also becomes an integral member. The arrangement of two integral members in series leads to an uncontrollably unstable behavior of the control circuit and, therefore, a control in this simple form is not possible.

A stable control behavior and a well defined web tension are obtained, when the compensating roller is made of a low mass and the speed of motion of the compensating roller is measured. In this case the compensating roller takes on a proportional integral control behavior, in the same way as when for instance the speed of the web in front of the input and behind the output is measured by means of two tacho-generators and the proportional auxiliary signal thus obtained is fed into the control circuit. The web tension is in this case obtained by, for instance, a pneumatic load of the compensating roller.

In these arrangements, it is disadvantageous, that means for electric or pneumatic measurement must be provided and that furthermore a power amplifier and a transmitter for the drive are necessary. Despite the high expense, the control range is smaller than desirable.

It is one object of the present invention to provide a winding device for webs which eliminates the mentioned drawbacks and which reduces the required expenditure.

It is another object of the present invention, to provide a winding device for webs which imparts the compensating roller a proportional control action with the least possible expense and in this connection retains the mass of the compensating roller as comparative value for the web tension.

It is yet another object of the present invention to provide a winding device for webs which includes an arrangement for the winding up of webs with predetermined web tension which is produced by the load of the web with a compensating roller which is arranged for movement in a loop formed by the web and the movement of which is utilized to control the winding up speed, in the manner that a draw-in roller is arranged in front of the loop of the web which is loaded by the compensating roller, which draw-in roller is adapted to be driven in synchronism with the peripheral speed of the roller determined by an air-squeeze roller.

A particularly advantageous further development of the present invention which further considerably simplifies the arrangement is possible by feeding the web about the air-squeeze roller on the side opposite the latter in such a manner, that it also assumes the function of the draw-in roller.

The invention can be used to particular advantage even for so-called support-roller windings in the manner, that the draw-in roller and the air-squeeze roller serve as supporting rollers for the roller.

With these and other objects in view, which will become apparent in the following detailed description, the present invention will be clearly understood in connection with the accompanying drawings, in which:

FIG. 1 is a schematic elevation of a winding device with a draw-in roller and an air-squeezing roller as well as a drive for the roll mandrel;

FIG. 2 is a schematic elevation of a winding device without a draw-in roller; and

FIG. 3 is a carrier-roll rewinding device.

Referring now to the drawings, and more particularly to FIG. 1, a web 1 is guided through a printing mechanism 2, via a guide roller 3, a draw-in roller 4, below a compensating driven roll 5 over another guide roller 6 to a roller 9 and wound up on same. An air-squeezing roll 8 presses the web firmly against the roller 9, so that a firm winding without air enclosures is produced, the air-squeezing roller being driven by the circumference of the roller 9 and itself driving a tacho-generator 10. The voltage of the tacho-generator 10 is amplified in an amplifier 11, which feeds a drive motor 12, which in its turn drives the draw-in roller 4 proportional to the circumferential speed of the roll 9. The roll 9 is mandrel-driven by a drive motor 13, the one field winding 14 of which is connected to voltage via an adjusting member 15, for instance a variable resistor, which is acted on by the compensating roller 5, while its second field winding 17 is fed from an amplifier 16, to which an input voltage is fed, which depends upon the pressure of guide roller 3 in its bearing, the latter being acted on by the tension of the web 1.

The manner of operation of this arrangement from a control standpoint is as follows:

The tension of the web is established by the mass of the compensating roller 5 suspended in the loop 7; which is designated by *qt*. The speeds with which the web 1 is transported, on the one hand, by the draw-in roller 4 and, on the other hand, by the roll 9 or the air-squeezing roller 8 coincide completely with each other and with the speed of conveyance of the web 1 through the printing mechanism 2. The tension of the web 1 and thus also its stretching, i.e., elastic elongation forced by tension, between the printing mechanism 2 and the draw-in roller 4, (tension hereinafter designated *qd*), corresponds to *qt*, and therefore stretching of web caused by tension *qd* corresponds to stretching of web caused by tension *qt*, the amplifier 16 receiving an input voltage by the pressure sensitive bearing of guide roller 3, which in its turn is dependent on the tension of the web. The compensating roller 5 imparts via the adjusting member 15 a predetermined voltage to the field

14 of the drive motor 13. The control system of the winding device is in equilibrium.

Two important disturbances of the web-tension equilibrium are now considered. The fast-stop of the printing machine in which *qt* suddenly and strongly increases and an abrupt acceleration of the printing machine, in which *qd* suddenly and strongly decreases.

Fast stop: *qd* increases strongly. The voltage, which is proportional to the web tension, fed to the amplifier 16 increases to the same extent and immediately influences the field 17 of the motor 13 in such a manner so as to reduce the rewinding speed of roll 9 so as to brake the roll 9. With the increase of *qd*, the stretching of the web 1 also increase in the region of the printing mechanism 2 up to the draw-in roller 4, which now conveys an excessively stretched web into the loop 7 in the same length, as it, as normally stretched web, is wound on the roll 9. In the loop 7, the length of web fed contracts, since in it the web tension $qt < qd$ prevails and this moves the compensating rollers 5 upwardly. The displacement of the setting member 15 effected thereby acts on the field 14 of the motor 13 also in such a manner as to reduce the winding speed.

The control function of the compensating roller 5 shows the customary integral control action, but with a very flat rise, since the compensating roller 5 is not, as customary, moved rapidly and strongly by differences in the web speed but, rather is moved slowly and only by a slight amount by the equalization in stretching. The web tension *qt* resulting from the mass of the compensating roller 5 is constant, and no substantial mass accelerating or retarding forces can occur at the compensating roller 5, since its movement takes place very slowly. The control is extremely stable.

Strong acceleration: *qd* drops strongly. The proportional voltage from the pressure sensitive bearing of the guide roller 3 via the amplifier 16 at the field 17 of the motor 13 acts immediately to accelerate the roll 9. The reduction of *qd* effects a reduction in the stretching of the web 1 in front of the draw-in roller 4. The section of the web conveyed into the loop 7 is subsequently elongated, since $qt > qd$, the compensating roller 5 descends, and influences via the adjusting member 15 the field 14 of the motor 13 likewise with the acceleration of the rewinding action.

The stability of the control action of this arrangement is further favorably influenced by the fact, that accelerations or retardations of the roll 9 in case of any slippage of the air-squeezing roller 8 on the latter act directly via the non-driven guide roller 6 on the compensating roller 5 via the speed.

The still present disadvantage of this arrangement, namely its still relatively high expense is avoided in the case of the embodiment shown in FIG. 2. The web 1 is conducted from the printing mechanism 2 around the guide roller 3 over an air-squeezing roller 8, a guide roller 18, under a compensating roller 5, over a guide roller 6 and 19 each and below the air-squeezing roll 8 onto a roller 9 which, as in the preceding example, is driven by a motor 13 having a field 14 which is adjusted by an adjusting member 15 independency of the position of the compensating roller 5. In this case the stretching of web caused by tension *qd* of web 1 between the printing mechanism 2 and the air squeezing roller 8 is transmitted directing via the air-squeezing roller 8 to the roll 9 and the function of the draw-in roller 4 of the preceding embodiment is taken over here directly by the air-squeezing roller 8. The tachogenerator 10, the amplifiers 11 and 16 as well as the drive motor 12 together with the draw-in roller 4 are therefore eliminated. Changes in stretching caused by a variation of the ratio $qd = qt$ act therefore likewise on the compensating roller 5 and the control, in the same manner as has already been described with reference to the preceding embodiment.

It is to be understood that in the embodiments described, the web 1 can be fed to the winding device not only from a printing mechanism 2 but from any desired device in which a web is produced, worked upon, treated or else merely rewound.

It is furthermore to be understood that the mandrel drive of the roll 9 has been indicated merely by way of example; the roller may instead also be driven on its circumference and even directly via the air-squeezing roller 8, which is supported in radially displaceable or swingable manner with respect to the support for the roller mandrel. It is furthermore possible to produce in any known manner an additional signal which is dependent on the diameter of the roller and with which the speed of rotation of the mandrel drive or of the circumferential drive and/or the tension of the web can be maintained variable as desired by acting on the loading force of the compensating roller 5.

In the example shown in FIG. 3, the web 1 is guided directly from the printing mechanism 2 to the draw-in roller 4, beneath the compensating roller 5 to the air-squeezing roller 8 and from there to the roll 9. The draw-in roller 4 and the air-squeezing roller 8 support and turn the roll 9 in the manner known in connection with carrier roll rewinding units and are driven with corresponding peripheral speed from a drive motor 20 having a field 21 which is adjusted via an adjusting member 15 as a function of the position of the compensating roller 5. This rewinding arrangement also is controlled in accordance with the principle which has already been explained; the stretching of web 1 caused by tension *qd* of the web 1 between the printing mechanism 2 and the roller 4 acts directly on the speed of the roller; the integral signal caused by tension *qt* and stretching of web in dependency of the tension *qt* between the roller 4 and air-squeezing roller 8 via the elongation of the web displaces the adjusting member 15 and thus controls the excitation of the field 21 of the motor 20.

In principle, it is not necessary that the air-squeezing roller 8 which serves as carrier roll and the draw-in roller 4 be driven jointly. In case of a free-moving roll 9 the drive of the draw-in roller 4 in itself is sufficient since no slippage can occur between the roll 9 and the air-squeezing roller 8. It is also possible to drive only the roll 9 by a controlled drive and to allow the draw-in roller 4 and the air-squeezing roller 8 to turn freely on their own as supporting rollers, without departing from the concept of the invention, since the peripheral speeds of the draw-in roller 4, the air-squeezing roller 8 and the roller 9 must coincide with each other.

While I have disclosed several embodiments of the present invention, it is to be understood that these embodiments are given by example only and not in a limiting sense.

I claim:

1. An arrangement for rewinding of a web on a roll, comprising

a roll means for rewinding a web thereon,

said web forming a loop in front of said roll means,

a draw-in roller means being arranged in front of said loop and said web passing thereon,

an air-squeezing roller means being arranged behind said loop and said web passing between said air-squeezing roller means and said roll means and pressing said web against said roll means and revolving with the peripheral speed of said roll means, and

means operatively connected to said air-squeezing roller means and to said draw-in roller means for rotating the latter with the peripheral speed of said roll means and said air-squeezing roller means,

a compensating roller means movably arranged in said loop formed by said web, and loading said web,

a driving means for rewinding sand web on said roll means, and

an adjusting means for controlling web rewinding speed of said driving means in dependency on the movement of said compensating roller means.

2. An arrangement for rewinding of a web on a roll, comprising

a roll means for rewinding a web thereon, said web forming a loop,

an air-squeezing roller means being arranged adjacent said roll means, a portion of said web in back of said loop passing between said air-squeezing roller means and said roll means and said air-squeezing roller means pressing said web against said roll means and revolving with the peripheral speed of said roll means,

a compensating roller means movably arranged in said loop and loading said web,

a driving means for driving said roll means for rewinding said web on said roll means,

an adjusting means for controlling web rewinding speed of said driving means in dependency on the movement of said compensating roller means, and

a portion of said web in front of said loop being guided on a side of said air-squeezing roller means remote from said roll means.

3. An arrangement for rewinding of a web on a roll, comprising

a roll means for rewinding a web thereon, said web forming a loop,

an air-squeezing roller means being arranged adjacent said roll means, a portion of said web in back of said loop passing between said air-squeezing roller means and said roll means and said air-squeezing roller means pressing said web against said roll means,

a draw-in roller means being arranged in front of said loop adjacent said roll means and pressing another portion of said web against said roll means,

a compensating roller means movably arranged in said loop and loading said web,

a driving means for driving said draw-in roller means and said air-squeezing roller means in the same direction with the same peripheral speed, said roll means being rotated by means of said draw-in roller means and said air-squeezing roller means with the same peripheral speed as that of the latter, and

an adjusting means for controlling web rewinding speed of said driving means in dependency on the movement of said compensating roller means.

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